# APPARATUS AND METHOD FOR VERIFYING REPEATABILITY OF SPECTROSCOPE, AND APPARATUS FOR ANALYZING SPECTRUM DATA

## CROSS-REFERENCE TO RELATED APPLICATION

**[0001]** This application claims priority from Korean Patent Application No. 10-2015-0108288, filed on Jul. 30, 2015, in the Korean Intellectual Property Office, the entire disclosure of which is incorporated herein by reference.

## BACKGROUND

**[0002]** 1. Field

**[0003]** The following description relates to an apparatus and method for verifying repeatability of a spectroscope, and an apparatus for analyzing spectrum data, which applies the apparatus and method.

**[0004]** 2. Description of the Related Art

**[0005]** A spectroscope is an instrument used to examine properties of light for a specific portion of the electromagnetic spectrum and typically used in spectroscopic analysis to identify materials. A measurement variable is generally the light's intensity, but could also be the polarization.

**[0006]** Due to the recent development of mobile devices, such as smartphones, tablet PCs, etc., health-care devices with a spectroscope combined with a mobile device are being developed. These health-care devices are minimized to be attached to or operate in association with smartphones or tablet PCs. In addition, these health-care devices can diagnose and manage a personal health condition and analyze all types of diseases quantitatively.

**[0007]** Meanwhile, due to the minimization of mobile devices, the size of the spectroscope being installed becomes smaller, and this may lead to difficulties in a precise diagnosis and analysis due to a spectroscope's performance degradation and an increase in noise that is caused by external environmental factor.

## SUMMARY

**[0008]** Exemplary embodiments address at least the above problems and/or disadvantages and other disadvantages not described above. Also, the exemplary embodiments are not required to overcome the disadvantages described above, and may not overcome any of the problems described above.

**[0009]** According to an aspect of an exemplary embodiment, an apparatus for verifying repeatability of a spectroscope that irradiates light to a user sample, detects light reflected from the user sample, and measures spectrum data of the user sample includes: a verifier to verify repeatability of spectrum data, measured by the spectroscope, based on predefined repeatability verification criteria; and a controller to control the spectroscope whether to remeasure the spectrum data based on the verification result.

**[0010]** The predefined repeatability verification criteria may include a similarity verification, a difference verification, a statistical verification, and a combination of two or more thereof.

**[0011]** In response to the similarity verification among the predefined repeatability verification criteria, the verifier may calculate a degree of similarity between a plurality of spectrum data, measured by the spectroscope, by using at least one of Pearson correlation, Kendall correlation, and Spearman correlation.

**[0012]** In response to the difference verification among the predefined repeatability verification criteria, the verifier may calculate a degree of difference between a plurality of spectrum data, measured by the spectroscope, by using at least one of Euclidean distance, Manhattan distance, and Hamming distance, and verify the repeatability thereof based on the calculated degree of difference.

**[0013]** In response to the statistical verification among the predefined repeatability verification criteria, the verifier may calculate statistical data of a plurality of spectrum data, measured by the spectroscope, by using statistical techniques that include at least one of a paired T-test and a paired Z-test, and verify the repeatability thereof based on the calculated statistical data.

**[0014]** The verifier may verify repeatability of currently measured spectrum data based on the predefined repeatability verification criteria by using at least one of values of mean and median of the spectrum data that is previously measured by the spectroscope.

**[0015]** The controller may in response to the spectrum data having failed to pass the repeatability verification, control the spectroscope to remeasure the spectrum data; and in response to the spectrum data having passed the repeatability verification, control an apparatus for analyzing spectrum data to analyze the measured spectrum data.

**[0016]** The controller may control the spectroscope by determining a number of remeasurement times, or control the apparatus for analyzing spectrum data by determining spectrum data to be analyzed, based on at least one of a number of spectrum data having passed the repeatability verification, a rate thereof, and a number of times that each spectrum data has failed to pass the repeatability verification.

**[0017]** According to an aspect of an exemplary embodiment, an apparatus for analyzing spectrum data includes: a spectroscopy unit, which includes a light source that irradiates light to a user sample, a detector that detects light reflected from the user sample, and a spectrum acquirer that acquires spectrum data from the detected light; a verifier to verify repeatability of the acquired spectrum data based on predefined repeatability verification criteria; and a calculator to generate user sample analysis information by analyzing at least a part of the acquired spectrum data based on the verification result.

**[0018]** The predefined repeatability verification criteria may include a similarity verification, a difference verification, a statistical verification, and a combination of two or more thereof.

**[0019]** The verifier may, based on the verification result, control the spectroscopy unit to remeasure the spectrum data, or control the calculator to analyze at least a part of a plurality of spectrum data acquired by the spectroscopy unit.

**[0020]** The verifier may control the calculator by determining spectrum data to be analyzed, based on at least one of a number of spectrum data having passed the repeatability verification, a rate thereof, and a number of times that each spectrum data has failed to pass the repeatability verification.